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ABSTRACT

Recent investigations of the cognitive components of human-environmental interactions owe much to the work of city planner Kevin Lynch, who hypothesized cognitive mapping as a two-way interactive process between individuals and their environment. Lynch identified five elements which individuals used in the construction of cognitive maps, specifically nodes (strategic areas), paths, edges, districts, and landmarks. It was hypothesized that Lynch's elements would be encoded in different modes of representation, and that these elements would be differentially elicited by the methods of externalizing cognitive maps. The memory components of cognitive maps in a model environment were investigated by means of actual and simulated "tours" using 60 adult subjects who were divided into three treatment groups: actual tour, dynamic film simulated tour (film of actual tour), and static film simulated tour (no movement in film). The "tours" were equated for time spent in each area of the environment. Results supported the hypotheses, suggesting that movement is an essential component in the organization and storage of cognitive maps, and that different methods of externalizing cognitive maps elicit different aspects of these internal representations. (Author)

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Modes of Representation in Cognitive Mapping

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Statement of the Problem

Recent investigations of the cognitive components of human-environmental interactions owe much to the work of city planner Kevin Lynch. Lynch (1960) revitalized research in cognitive mapping with his study of individuals' representations of their home cities. He found five elements were used in the construction of cognitive maps: nodes (strategic areas), paths, edges, districts, and landmarks. These elements were used in free map drawings, reconstructions, and free verbal descriptions of cities. Lynch hypothesized cognitive mapping as a two-way interactive process between individuals and their environment.

Many cognitive psychologists support Lynch's ideas in suggesting environmental perception is a constructive process (Gombrich, 1975; Gregory, 1974; Hochberg, 1975). Bruner proposed that three developmental modes of representation are used in knowning the environment (Bruner, Olver, & Greenfeld, 1966). These modes he labeled enactive (habitual actions), ikonic (imagery), and symbolic (language) representation.

With Bruner's theory and Lynch's model in mind, the present study investigated the structural bases of cognitive maps. It was proposed that Lynch's elements would be encoded in different modes of representation: paths and nodes - enactive, edges and landmarks-ikonic, and districts-symbolic. Furthermore, these elements would be differentially elicited by the methods of externalizing cognitive maps (mapping should result in more paths and nodes; while written descriptions should produce more districts and landmarks).

Method

Subjects. The sample consisted of 60 adult museum visitors (28 males,

32 females). Subjects were randomly assigned to one of three treatments and tested in small groups.

Procedure. Components of cognitive maps were studied by means of filmed simulations and actual tours through the Philadelphia Art Museum. An interior environment was chosen in order to closely simulate real-world conditions. It offered less auditory and olfactory stimulation, which could not be easily simulated, and the use of an interior space could be more easily filmed than the unlimited height and horizon of outdoor settings. Treatment consisted of: 1) Dynamic Simulation - subjects viewed a 16 mm film that provided a feeling of movement and redundancy of environmental information (similar to an actual walking tour); 2) Static Simulation - subjects viewed a 16 mm film with no movement, which presented a sequential restricted view of the environment (similar to a slide presentation); 3) Tour - subject took a walk-through tour of the galleries. All treatment groups received the same amount of time in each of the 13 rooms used in this study for a total of 15 minutes for film/tour. Subjects were informed they would be tested on their ability to find their way around the galleries and to communicate this information to others.

Following the experimental manipulation, subjects received four tests of their cognitive maps: 1) free map drawing, 2) free written description, 3) a forced-choice recognition test - consisting of 15 target items which were seen on the tour/film and 15 nontarget items not seen before, and 4) a written association test. The order of the tests was counterbalanced.

Results

A one-way analysis of variance performed on the percent correct scores for the recognition test showed a significant effect for treatment ($F = 11.19$,

df = 2/5, p <.01). Post-hoc comparisons of the groups showed that the Tour Group did better than either of the simulations and that the Dynamic Simulation Group did better than the Static Group (p <.05, Neuman-Keuls).

The maps and written descriptions were scored for percent correct on placement and identification of each room as well as for accuracy and frequency of use of Lynch's elements: the specific instances of nodes, paths, landmarks, and districts used in maps and written descriptions (Figures 1 and 2).

A 3 (treatment) x 2 (score) repeated-measures analysis of variance performed on the map data produced a significant effect for treatment (F = 33.12, df = 2/57, p <.01). Analysis of the treatment effect produced results similar to the recognition test (Tour > Dynamic and Static Simulations, p <.05, Newman-Keuls). A 3 (treatment) x 2(score) repeated-measures analysis of variance performed on the written description data produced a significant effect of treatment (F = 19.36, df = 2/57, p <.01). The post-hoc analysis of this effect showed the Tour Group produced more accurate descriptions than either of the simulations (p <.05, Newman-Keuls). There were no significant differences between the placement and identification scores on either the Sketch Maps or the Written Descriptions.

Figure 1 and 2 show the percentage of correct usage of Lynch's elements for each of the three treatment groups for both maps and written descriptions. The maps elicited more nodes and paths than other elements and more than were elicited by the written descriptions. In general, the written description elicited more nodes and districts than other elements.

Results concerning the effect of the method of environment presentation on cognitive mapping behaviors supported the hypotheses put forth. The Tour

group produced more accurate results than both the Dynamic and Static Film groups on all of the cognitive mapping tasks. The results of the usage of environmental elements on the Sketch Maps and the Written Descriptions showed that the Dynamic Film group produced more paths and nodes than the Static Film group. The pattern of element usage on the cognitive mapping tasks were the same for the Tour group and the Dynamic Film group; suggesting that the subjects in the Dynamic Film group used the same structural basis to encode and decode their cognitive maps as were used by the subjects in the Tour group.

Conclusions and Implications

In general the model of the structural bases of cognitive maps was supported. The five environmental elements appear to be encoded differently within the modes of representation. Based on the results of the present study, the model accurately accounted for the cognitive structures of paths and districts. Further investigation is needed to fully understand the structure involved in the storage and usage of nodes and landmarks.

The types of cognitive mapping tasks used to externalize subjects' knowledge of their environment was found to be a significant factor in assessing subjects' cognitive maps. If an investigator is primarily interested in the elements of an environment a subject has stored in memory, then recognition and probe recall (association) tasks will be sufficient to assess this level of knowledge. But, if the primary interest is to understand the relationship between environmental elements, then the free recall procedures of maps and written descriptions should be used. These tasks reveal more of the underlying structure of cognitive maps through the usage of elements and relationships between elements they elicit.

The final conclusion to be drawn from this study is that the more interaction an individual has with the environment the more complete his or her cognitive map will be. Rudimentary knowledge of an environment can be obtained through static presentation, but in order to develop the relationships between elements of the environment the addition of a film simulated interaction is needed. Future studies in the area of cognitive mapping should be aware of the benefits that an ecologically valid approach has for the understanding of human way-finding behaviors.

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Figure Captions

Figure 1. Total percentage of Lynch's elements correctly used by each treatment group in free map drawings.

Figure 2. Total percentage of Lynch's elements correctly used by each treatment group in free written descriptions.

FIGURE 1

MAPS

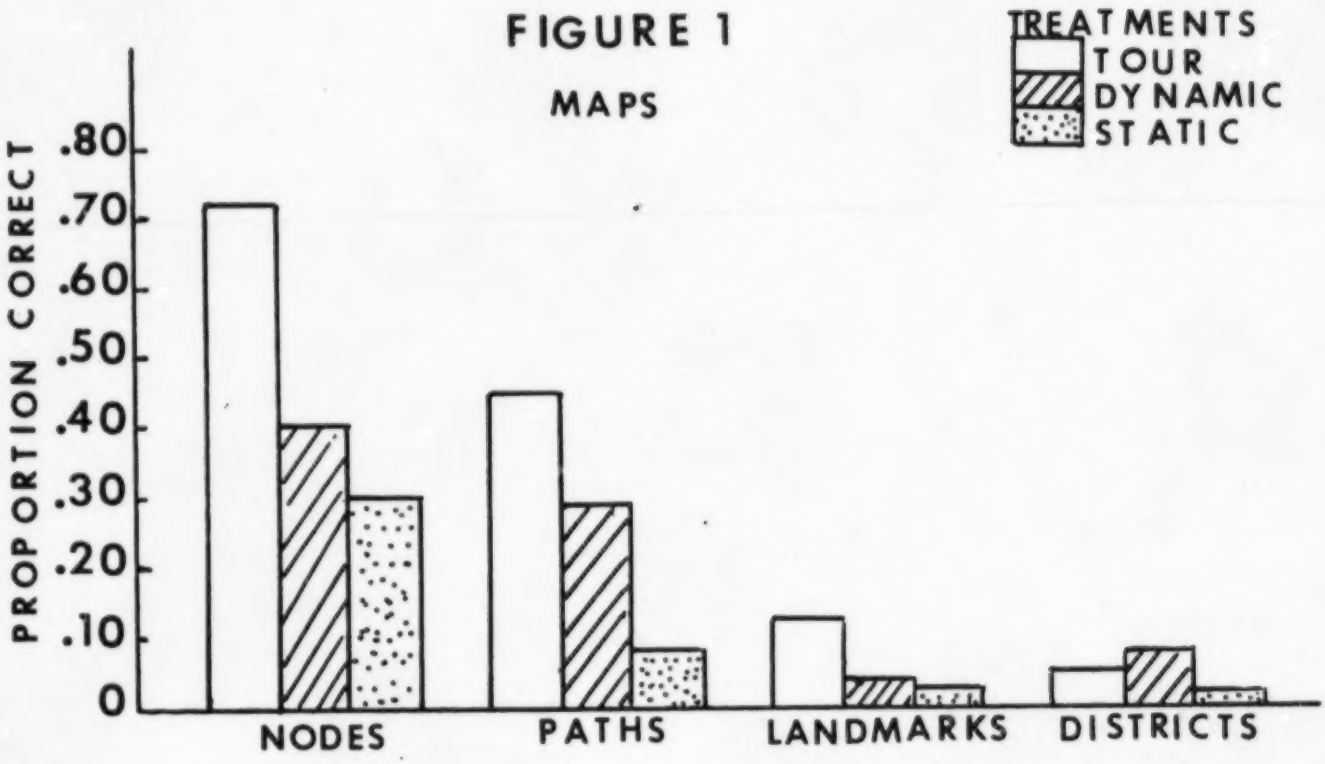

FIGURE 2

WRITTEN DESCRIPTIONS